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Catalyzing political momentum for the effective implementation of decarbonization for urban buildings

Abstract

This paper expands the toolkit available to consider the effectiveness of urban climate responses by examining political effectiveness in the implementation of urban decarbonization initiatives. By focusing on the politics of implementation, this approach complements dominant approaches for assessing the effectiveness that emphasize greenhouse gas emission accounting. Drawing on case studies of urban building low carbon governance in Stockholm, London and San Francisco incorporating 40 expert interviews, the analysis provides insight into whether climate change mitigation measures are catalyzing political momentum that is untangling fossil fuels from institutions. It finds that urban decarbonization is gaining political momentum when it comes to new buildings, although with concerning implications for inequality and uneven development, but systemic change is limited since efforts to target existing buildings are stumbling over challenges. Two key insights are highlighted: 1) reframing the policy goal of urban climate mitigation to decarbonization productively refocuses attention on systemic change; 2) effective urban carbon governance is not only about providing instrumental tools, but it also involves triggering political dynamics that build momentum. Future urban decarbonization initiatives should consider the complementary roles of offering instrumental solutions and catalyzing political momentum through implementation.

1. Introduction

Urban carbon governance takes many forms and involves many players. Though local governments are playing a pivotal role, other actors such as citizens, business groups and international organizations are also intervening in urban systems to try to reduce urban greenhouse gas emissions (Bulkeley & Betsill, 2013; Castán Broto & Bulkeley, 2013). These urban climate change response activities are growing in scope and prominence. Given the diversity of the responses, evaluating success can be complicated. Nonetheless, a limited number of tools to measure success have gained popularity, especially greenhouse gas (GHG) accounting and GHG reduction targets (Bulkeley, Broto, & Edwards, 2012; Erickson & Morgenstern, 2017). However, these calculative approaches to evaluate progress in the implementation of decarbonization initiatives often overlook social and political considerations (Fuller, 2017; Rice, 2015), which can make decarbonization appear to be about solving a carbon math problem rather than engaging in a contested political process (van der Ven,

Bernstein, & Hoffmann, 2017). Despite their dominance in policy and research, GHG accounting approaches do not provide a complete understanding of effectiveness in the implementation of urban climate change responses. It is also important to develop more detailed understandings of how to embed decarbonization and how to implement politically effective urban climate change mitigation responses.

This paper expands the toolkit available to consider the effectiveness of urban climate responses by examining political effectiveness in the implementation of urban decarbonization initiatives. This paper takes one approach to political effectiveness using a political dynamics of decarbonization framework (Bernstein and Hoffmann, 2018). Drawing on case studies of urban building low carbon governance in Stockholm, London and San Francisco, I evaluate whether climate change mitigation measures are catalyzing political momentum that is untangling fossil fuels from societal institutions. In particular, I examine whether urban decarbonization initiatives are building political momentum by scaling up and/or becoming more durable when supported by the political mechanisms of normalization, capacity building, and coalition building, and also whether they are catalyzing trajectories toward transformational decarbonization where systems generate zero use of carbon-based energy. This paper advances two main arguments. First, reframing the policy goal of urban climate mitigation to decarbonization productively refocuses attention on systemic change. Second, effective urban carbon governance is not only about providing instrumental tools, but it also involves triggering political dynamics that build momentum.

The paper proceeds in the following sections. In section 2, I review considerations of progress in the implementation of urban climate mitigation responses and argue that decarbonization offers a new starting place from which to consider political effectiveness in urban decarbonization implementation. Section 3 outlines the case studies and research

methods. I examine the ways in which political mechanisms are enabling decarbonization initiatives to expand and become more durable over time in the three case studies in Section 4. In section 5, I discuss the implications for the development political momentum towards decarbonization before concluding in Section 7.

2. Effective urban carbon governance

2.1 Considering progress in the implementation of urban decarbonization initiatives

Urban decarbonization will require multi-scalar low carbon transformations to urban material, political and institutional infrastructure systems (Bulkeley, Castán Broto, & Maassen, 2011). Some climate change mitigation efforts in cities are now targeting a transformative scope of change (for example, see CNCA [2015]). Building-oriented decarbonization initiatives, which are the focus of this paper, target issues like energy efficiency, on-site renewable energy generation, and integrated energy demand reduction measures (Castán Broto & Bulkeley, 2013). However, it is not clear what successful urban decarbonization will look like since urban responses to climate change span a wide breadth of targeted systems, instigating actors, and governance approaches (Bulkeley & Betsill, 2013; Castán Broto & Bulkeley, 2013; Emelianoff, 2014; Peng & Bai, 2018). Research has shown what kinds of climate change policies are being implemented (Castán Broto & Bulkeley, 2013) and that there are an increasing number of urban climate initiatives (Bulkeley & Betsill, 2013), but we do not know which initiatives are successfully addressing climate change since many decarbonization initiatives are experimental and uncertain in their impact (Hoffmann, 2011). Furthermore, the entrenchment of fossil fuels in society creates a policy inertia that makes it difficult to make systemic change (Unruh, 2002). Therefore, measuring effectiveness in the implementation of decarbonization initiatives is challenging.

Calculative approaches to GHG emission monitoring dominate in the evaluation of climate mitigation action effectiveness. Urban actors have frequently used GHG emission reduction targets (e.g. 20% lower GHGs by 2020 from 1990 levels) and other related indicators (e.g. 100% renewable energy by 2030) (Bulkeley, 2013). Progress toward these goals is measured through data-driven climate change mitigation tools like carbon footprints and greenhouse gas emission inventories (Hughes et al., 2019). Success is also being measured by adding up the proposed GHG impact of local decarbonization initiatives, which is the approach taken by "orchestration platforms" (van der Ven et al., 2017) run by transnational actors that seek to value the climate governance initiatives of non-state and subnational actors. Studies have also sought to consider effectiveness in urban climate governance by comparing outcomes to targets using best practices, indicators, policy representations or greenhouse gas reporting (Kennedy, Demoullin, & Mohareb, 2012; Reckien et al., 2014; Zimmerman & Faris, 2011). However, there are common limitations to many of these tools meant to measure effectiveness of urban climate action.

At times, the lack of political consideration of GHG accounting tools makes it difficult to consider social and political implications (Fuller, 2017; van der Ven et al., 2017). Not only are formal reporting systems centred on GHG accounting failing to comprehensively capture climate responses underway in cities (Robinson and Gore, 2015), but the contested nature of urban decarbonization is also occluded when carbon governance is reduced to GHG emission reduction units deployed through behaviour modification or technological substitution. These calculative approaches to evaluating progress "potentially [reduce] decarbonization to a problem of making the numbers add up" (van der Ven et al., 2017). To understand effective climate mitigation responses, we also need to examine the politics of implementation.

There are recognized barriers to local climate change action that make implementation far from a certain success. Barriers to implementation include a lack of prioritization of climate change responses by political leadership, emphasis on business friendly environment, lack of technical and institutional capacity, lack of financial resources, and lack of information about how to respond (Robinson & Gore, 2005; Romero-Lankao, 2012; Schreurs, 2008). The implementation of urban climate action is a process that depends on the politics of collaboration, contestation and negotiation (Rutherford, 2014; Silver, 2017; Edwards and Bulkeley, 2017). As the work of others has shown, the implementation of urban climate responses is influenced by political dynamics playing out through, for example, leadership and institutionalization in local government (Burch, 2010a), policy champions (Anguelovski and Carmin, 2011), and processes of narration and ordering (McGuirk et al., 2016). The politics of implementation have a significant influence on how (and whether) urban climate action unfolds, but commonly used evaluation tools for urban decarbonization effectiveness are limited in their ability to provide insight into how political dynamics are shaping these outcomes. Therefore, I argue that the toolkit used to evaluate effectiveness can be productively expanded to include approaches that examine political effectiveness in the implementation of urban decarbonization.

2.2 Evaluating political effectiveness using a political dynamics of decarbonization framework

Decarbonization offers a different starting place to consider the question of urban climate action effectiveness. Decarbonization is the reversal of the entrenchment of fossil-fuel energy systems. These systems have been produced by the co-evolution of technological and institutional systems in industrial economies or “carbon lock-in” (Unruh, 2000). Decarbonization requires the disruption of carbon lock-in through the transformation of societal institutions (Unruh, 2000, 2002). Within this framing of the problem, effective climate change mitigation

depends on overcoming carbon lock-in. Short-term actions can incrementally improve the greenhouse gas emission performance of a system (e.g. replacing coal with natural gas), but a decarbonization frame recognizes that this is only an incremental improvement that fails to reverse the entrenchment of fossil fuel interests. In this paper, I use urban carbon governance to mean the explicit effort to decarbonize the city (McGuirk, Bulkeley, & Dowling, 2014).

This paper uses a political dynamics of decarbonization framework to consider political effectiveness in the implementation of urban decarbonization initiatives (Bernstein and Hoffmann 2018). There are two reasons to use this framework. First, a focus on decarbonization requires an emphasis on the politics of triggering systemic change. Most analyses of decarbonization prioritize technological or economic dynamics, but "disrupting carbon lock-in is fundamentally a political activity because lock-in has significant political foundations: It rests on norms, institutions, capacities, and coalitions that support fossil energy dependent systems" (Bernstein and Hoffmann 2018). Second, the framework allows for forward theorizing and a method of analyzing the *potential* for transformation, which is important given this paper's focus on nascent decarbonization initiatives.

Bernstein and Hoffmann (2018) argue that decarbonization will be driven by political decisions that enable technological and behavioural change and that decarbonization initiatives will change systems by contributing to the political mechanisms of normalization, capacity building, and coalition building. In particular, these mechanisms may allow decarbonization initiatives to scale up and become entrenched over time (Bernstein and Hoffmann 2018). The political mechanisms of normalization, capacity building, and coalition building (see Table 1) are drawn from literature on the politics of systemic change (Bernstein and Hoffmann 2018). *Norm change* is an influential source for shifts in public interest and what is understood to be 'good' governance (Bernstein & Cashore, 2012; Selin & Vandeveer, 2005). *Capacity building* alters the

means to act by providing support through funding, training, technology etc. (Bernstein & Cashore, 2012). *Coalition building* is the development of economic and political support for decarbonization by altering incentives or harnessing market forces. Policies that incentivize renewable energy, for example, seek to create new coalitions of support for renewable energy by creating new groups of 'winners' (Bernstein & Hoffmann, 2018; Stokes & Warshaw, 2017). The three political mechanisms are considered separately in this framework for analytical purposes, but they frequently interact (Bernstein and Hoffmann 2018).

Table 1 Elaboration of political dynamics of decarbonization (adapted from Bernstein and Hoffmann, 2018)

Political mechanisms of systemic change	**What does this look like in political terms for urban decarbonization?**
Norm change	- Discursive shifts in what is held to be in the public interest, which affects public policies and political expectations - Entrepreneurs propose new ways of looking at the world and addressing problems such as climate change - Everyday practices can build-up and shift ideas about the appropriateness of climate action
Coalition building	- The development of coalitions of economic and political support for decarbonization - Coalition building takes place when actors who have an interest in climate action are empowered or new constituencies are created by altering (dis)incentives - Social movement building and using market forces are two ways this can take place
Capacity building	- Building capacity to take decarbonization action through material, institutional, or cognitive means - Capacity can be provided when initiatives provide it directly (e.g. grants) or can be developed through initiatives such as co-governance between public and private sector actors

	- Decision-making processes or program implementation can be altered when decarbonization initiatives generate institutional capacity (e.g. within governments)

Decarbonization policies and practices can scale up or become entrenched when they are supported by these mechanisms. Scaling can take many different forms. Decarbonization initiatives can grow in scope (e.g. expand from energy retrofits for commercial buildings to also include residential buildings), but they can also enable a large ecosystem of complementary decarbonization initiatives (e.g. an energy efficiency financial incentive program that spurs capacity building programs and energy audit industry expansion) and inspire policy diffusion in new places (e.g. local green building standards adopted at the national level) (Bernstein and Hoffmann 2018). In conjunction, policy changes can become entrenched through path-dependent processes. In considering how a policy becomes entrenched over time, it is important to consider any increases in the durability of changes (e.g. incorporated into legislation), the expansion of the populations the changes cover (e.g. new groups join the population originally targeted by the policy), increasing returns garnered by participants in the change, and increased costs for those that do not participate in the change (Levin, Cashore, Bernstein, & Auld, 2012). Initiatives that are scaling up or are becoming entrenched have the potential to contribute to transformative change (Bernstein and Hoffmann 2018). These political dynamics can catalyze three possible trajectories for targeted systems: 1) reinforcement of carbon lock-in, 2) increased efficiency in carbonized systems or 3) “transformational decarbonization, a phase change whereby fossil energy (and/or other GHG generating processes) is not just lessened, but a new trajectory toward replacement or zero use of carbon-based energy is generated” (Bernstein and Hoffmann 2018).

In sum, I draw on this framework to argue that politically effective implementation of urban climate mitigation responses:

1) Builds political momentum by scaling up and/or entrenching decarbonization initiatives through the support of the political mechanisms of normalization, capacity building, and coalition building, and;
2) Create trajectories toward transformational decarbonization where systems generate zero use of carbon-based energy.

After explaining the methods and case studies, I analyze the cases for the presence of normalization, coalition building and capacity building to examine the ways that these three political dynamics are enabling the scaling up and entrenchment of decarbonization initiatives, as well as the implications for decarbonization trajectories.

3. Research methods

I chose Stockholm, London and San Francisco as case studies based on three criteria: international leadership in carbon governance, heterogeneity within that leadership group, and evidence of leadership in building decarbonization. Membership in the Carbon Neutral Cities Alliance (CNCA) met the first criterion, which is a transnational municipal climate governance network founded in 2014 by 17 local governments. As the members themselves describe, CNCA members are local governments adopting “the most aggressive GHG reduction targets undertaken by any cities across the globe” (Carbon Neutral Cities Alliance, 2015:p.ii). This group is important to study, despite geographic limitations emphasizing wealthy cities in North America and Europe (see table 2), since the members are self-identified pioneers of urban “deep decarbonization” (Carbon Neutral Cities Alliance, 2015) that are blazing a trail they intend others to follow. To meet the second criterion, I selected cities with maximum variety in terms of

demographics, climate, urban form and institutional setting (e.g. regulatory strength of municipal government, alignment with national climate policies) within the scope allowed by the CNCA membership. Finally, I selected locations where climate response strategies including initiatives aimed at building energy efficiency and low carbon energy for buildings. Since I used buildings as an entry point into processes of urban decarbonization, this criterion was key. Note that there are many climate response strategies pursued by urban actors, although buildings are a popular target (Castán Broto & Bulkeley, 2013; Kennedy, Ibrahim, & Hoornweg, 2014). I selected cases where there was evidence of carbon governance of buildings over at least a five year period, which I assumed was enough time for implementation to have occured. Key contextual information about the case studies (Stockholm, London and San Francisco) is summarized in Table 3.

Table 2 Members of the Carbon Neutral Cities Alliance (USDN, 2015)

Berlin, Germany	Minneapolis MN, USA	Stockholm, Sweden
Boston MA, USA	New York City NY, USA	Sydney, Australia
Boulder CO, USA	Oslo, Norway	Vancouver, Canada
Copenhagen, Denmark	Portland OR, USA	Washington DC, USA
London, United Kingdom	San Francisco CA, USA	Yokohama, Japan
Melbourne, Australia	Seattle WA, USA	

Urban carbon governance is multi-level and involves action taken by a range of different stakeholders across local, national and global spheres (Bulkeley & Betsill, 2013). Actors and institutions are setting decarbonization targets at multiple policy scales – from municipal (e.g. the City of Stockholm's goal to be fossil fuel free by 2040) to international (e.g. EU directives on zero net energy buildings) – and these targets all intersect at the urban scale when they are

implemented in buildings and energy. Therefore, this paper examines carbon governance affecting Stockholm, San Francisco, and London's urban systems whether it is driven by a neighbourhood group, local government, state agency, national government, transnational network etc. The framework's three political mechanisms (norm change, capacity building and coalition building) work in the same way at every level.

This study does not compare the case studies in order to find causal factors, select best practices, or to choose a winner. Instead, I draw on data from three urban contexts in an interpretive approach to theorization of urban decarbonization. During five-week field visits to each case study site in 2015-2016, I conducted interviews with representatives from the urban development industry (n=12), government (n=18), utilities (n=2), building owners (n=2) and non-governmental organizations (n=6) who were involved in building and energy decarbonization over five week field visits to each case study. The interviews were transcribed and thematically coded. I also did a documentary analysis of about 50 relevant policy documents and reports (such as municipal government plans) and conducted 19 building tours and site visits, including in-depth and self-directed tours of buildings (single-family homes, commercial buildings etc.) as well as site visits to urban energy infrastructure and eco-districts. I interviewed a community of practitioners and policymakers striving to achieve decarbonization in their cities. This community's effort to achieve decarbonization represents a political struggle against entrenched interests embodying pervasive carbon lock-in across social, institutional, technical and economic systems. However, this was an elite group of actors and it is important to note that the decarbonization initiatives referenced in this paper do not represent a consensus about the nature of climate governance.

Table 3 Case study key context, targets, policies, and indicators of progress

	Population	Relevant Targets and Context	Indicators of Progress	Key Policies and Programs
Stockholm	901,000	Fossil fuel free by 2030 for city operations and 2040 for the whole city; Reduce per capita emissions to 2.3 tons CO_2eq/capita by 2020; Halve the energy use of the existing building stock by 2050 (from 1995 levels) (City of Stockholm, 2016) EU direction to achieve near zero energy in new buildings by 2020 (Hermelink et al., 2013) Sweden's goals are to reduce GHG emissions 40% from 1990 by 2020 and no net GHG emissions by the year 2050 The Swedish Building Code requires a high degree of efficiency (Hermelink et al., 2013) The City of Stockholm owns about 20% of the buildings in the city and 70% of the land area (City of Stockholm, 2012) District heating meets 80% of Stockholm heating needs, facilitated by a history of communal building ownership (Dzebo & Nykvist, 2017).	Stockholm's GHG emissions reduced approximately 56% between 1990-2016 (C40 Cities, 2017) 30% reduction (from 1995 levels) in energy use in existing building stock (City of Stockholm, 2016) Most city-wide GHG emission reductions to date have been achieved due to fuel switching to non-fossil fuels for district heating, such as biofuels and waste incineration	Local government and agencies are required to reduce energy use by 10% between 2016-2019 New buildings on city-owned land required to meet a high energy efficiency standard (max 55kWh/m^2) Energy efficiency demonstration projects Solar photovoltaics installation, particularly on municipally owned buildings. Eco-districts Hammarby Sjöstad and Stockholm Royal Seaport, where new developments are required to meet higher environmental standards
San Francisco	860,000	100% renewables goal: by 2030, residential electricity is planned to come from renewable sources and 80% of commercial electricity use is planned to come from renewable sources (City of San Francisco, 2013) California building code targets: new residential buildings to be Zero Net Energy by 2020, commercial buildings in 2030 California Global Warming Solutions Act (2006): reduce GHG emissions to 1990 levels by 2020 In 2016, electricity customers in San Francisco began to be automatically transitioned to the municipally owned utility program CleanPowerSF, which sells customers electricity incorporating a higher percentage of renewable energy at the same cost	San Francisco's GHG emissions city-wide decreased 14.5% between 1990 and 2010 (San Francisco, 2013) 7.9% reduction in energy use among commercial properties that regularly comply with the Benchmarking Ordinance (SF Environment, 2015) Increased renewable energy because of the California's Renewables Portfolio Standard (San Francisco, 2013)	San Francisco's Green Building Code (since 2008), requiring energy efficient new and majorly retrofitted buildings linked to the LEED and GreenPoint Rated green building rating systems San Francisco's Energy Benchmarking Ordinance for commercial buildings Renewable energy supply through CleanPowerSF Capacity building programs including Energy Upgrade and Energy Watch

		as the electricity that they were previously sold from the investor-owned utility		
Greater London Authority (GLA)	8.6 million	The GLA acts as a regional government above the 33 boroughs of London GHG reduction target of 60% (below 1990 levels) by 2025 (Mayor of London, 2016) Zero carbon city by 2050 (Mayor of London, 2016) 25% of the heat and power used in London to come from local decentralized systems by 2025 (City of London, 2015) UK Climate Change Act: reduce greenhouse gas emissions by at least 80% of 1990 levels by 2050 Reduced coal combustion in the UK (reduced GHG emissions for electricity) EU directive to achieve near zero energy in new buildings by 2020 UK Zero Carbon Homes target by 2016 (cancelled in 2015)	London's GHG emissions decreased 16% between 1990 and 2014 and per capita emissions estimated at 4.4 tonnes in 2014 (Mayor of London, 2017) Average energy efficiency savings 30-40% above national building code requirements since 2007 on large urban developments (City of London, 2015) Retrofits of 500,000 homes in London and 400 public sector buildings by 2014 (Mayor of London, 2015)	RE:FIT and RE:NEW GLA energy efficiency programs Energy Company Obligations for energy efficiency The London Plan energy requirements for new large developments The London Green Fund Decentralized and renewable energy development is also pursued by the boroughs. For example, the borough of Merton requires new developments to provide 10% of its energy use from on-site renewable energy generation Renewable energy development is also being funded through community initiatives e.g. Brixton Energy

4. Political processes catalyzing systemic change

In this section, I examine how the political dynamics of normalization, coalition building and capacity building are catalyzing the scaling up and entrenchment of decarbonization initiatives in the case studies.

4.1 Normalization

Decarbonization is being entrenched into building standards through the support of changing norms about what constitutes 'good' urban development. In particular, 'good' is starting to align with 'low carbon' in some places due to new expectations about urban futures. Decarbonization targets set at multiple scales are creating expectations for the future that urban actors have found they could leverage. As one participant in the research explained, the broader policy context in the UK supported the more stringent low carbon building requirements enforced by the Greater London Authority (GLA):

> "…there was a separate parallel trajectory in [the UK] government called zero carbon buildings and zero carbon homes, so that provided us with an extra stick. We didn't have [the requirement yet] because that was going to be enforced in the future, but we could point to the direction of travel and say well you're going to have to get there anyway" (London energy consultant, interview, Oct 5 2015).

As this quote shows, the broader policy context in the UK influenced expectations about the future. Local government actors in the GLA leveraged these norms about urban development to

entrench decarbonization into the GLA's urban development standards. A similar dynamic is taking place in California. The state has aspirational goals for zero net energy for new residential buildings by 2020 and new commercial buildings by 2030 (California Energy Commission, 2007). There is evidence of entrenchment since these goals are significantly influencing state building code standard revisions (San Francisco environmental non-profit representative, interview, Apr 20 2016). Despite the fact that ZNE is "a goal without teeth", "people want to move that direction so this goal helps drive it" (San Francisco environmental non-profit representative, interview, Apr 20 2016). The goal represents expectations about future building standards so that, even though nothing happens if the goal is not met, actors can leverage the associated norms about good urban development to entrench decarbonization into the building code. In addition, the normalization of energy efficient building standards at the state level has facilitated the adoption of even higher standards in San Francisco, particularly because energy requirements were already ingrained into the development industry (San Francisco consultant, interview, Apr 19 2016). This supports previous findings that policy signals from higher levels of government can enable (and impede) local action (Burch, 2010b), and identifies norm change as a key political dynamic at play. New urban development norms about the inevitability and desirability of low carbon buildings can catalyze the entrenchment of decarbonization into building standards.

Furthermore, normalization was also a key dynamic facilitating the move from voluntary to mandatory requirements for low carbon buildings and energy. In San Francisco, the local government first established a financial incentive program for solar PV installation in 2008 called GoSolarSF. They did not require solar to be installed through the local green building code because, as one former municipal employee explained, "we couldn't get a mandate passed back then. We didn't even try it because we knew it wouldn't get passed. But…you do the incentive programs and that gives people the heads up that that's the direction you're heading in

and then, now they're looking at the mandate" (San Francisco environmental non-profit representative, interview, Apr 5 2016). In 2013, California started to require that new buildings be solar ready, which meant that developers had to leave roof space that is suitable for installing solar available. The development industry had gotten used this requirement by 2016 when the City of San Francisco began to require that some new buildings install solar PV in that saved space (City of San Francisco environment department representative, interview, Apr 14 2016) (while still maintaining the financial incentive program). Similarly in the UK, some building features made familiar to the building industry through voluntary adherence to the green building code BREEAM have been incorporated into the regulated building code (London environmental non-profit representative, interview, Sept 21 2015). Norm change can facilitate entrenchment of decarbonization by supporting the progression from voluntary incentives to mandatory requirements.

Cultural and professional norms affecting individuals were key factors enabling decarbonization activities to scale up. Decarbonization for buildings requires that designers, engineers and planners adopt some new practices. Given the reinforcement of norms by professional institutions, it can be difficult to enable broad changes to standards of practice. As a municipal government employee explained, "[Swedish planners] have a planning manual that comprises, maybe 1000 pages…we have to follow standards, we have to follow regulations, we have to follow procedures…As a planning architect, as you get forced into that manual, and bringing in new things is difficult" (City of Stockholm planning department representative, interview, Nov 5 2015). Clearly, changing norms can be challenging, but the integration of decarbonization into professional norms and institutions is particularly important. For instance, retrofit requires new practices to become accepted in the development sector:

> "…Even though a lot of this technology already exists,
>
> certain technologies are favoured by designers, certain

> technologies are favoured by owners or developers… [and] contractors might not be familiar with a certain technology…Because it's not enough to just say 'Hey, it's this great new thing that's going to save you a lot of energy'. If people don't know how to install it, don't know how to maintain it, don't perceive it to be as easy or easier to use, then they're not going to put it in" (San Francisco consultant, interview, Apr 29 2016)

As this quote demonstrates, scaling is facilitated by familiarly with new practices. In the case studies, broader shifts in professional norms were taking place and facilitating the scaling up of decarbonization initiatives. In Stockholm, a representative from the development industry described how good development used to mean meeting energy efficiency standards, but "it shifted in the early 2000s. If you didn't beat the standard by 20% you weren't really good" (Stockholm development industry representative, interview, Nov 23 2015). In the face of progressively rising energy efficiency standards, normal practice in the development sector can shift. Over time, norms may expand beyond particular professions to become a broader cultural norm connected to a place. In Stockholm, the cultural norm of pursuing transformation for decarbonization supported scaling:

> "We have been doing systematic [climate] work for a very long time. And we are doing things that you think, people ask, like you asked, why are the heating companies doing this? And it's a lot of things. And why is the public transport company putting a lot of biofuels in the buses? Because we want to do something that is good" (City of Stockholm environment department representative, interview, Nov 28 2015)

Decarbonization becomes a broader cultural norm and new carbon governance initiatives build on this cultural dynamic. In San Francisco, after decades of climate and energy action, there is "an enlightened business community. Not on every single thing, but in general many of the large developers see the value of green building" (San Francisco environmental non-profit representative, interview, Apr 5 2016). Plans to design a new downtown district energy system (which is a rarity in San Francisco) were met with support by developers. This response led one municipal employee to remark, "I think that was a San Francisco thing" that the developers said to themselves "This is not crazy, and actually, our tenants are probably going to love it" (City of San Francisco planning department representative, interview, Apr 14 2016). Decarbonization activities can be scaled up through shifts in professional norms that, over time, can build into broader cultural norms.

4.2 Coalition building

Coalition building within the development sector supported the entrenchment of decarbonization into mandatory standards. In Stockholm, for instance, a downtown neighbourhood called the Royal Seaport is held to higher environmental standards than the rest of the city. The specific standards were developed through a dialogue between city employees and development sector representatives. One development sector consultant described the collaborative dynamic of the process:

> "We were part of that development in the beginning when it came to Royal Seaport where they invited all the developers, their architects, their consultants…to have an open forum discussing the goals, the visions. If this mission is twice as good, how is that going to happen? What does that mean? How can we break it down? What kind of energy goals do we

> need?…The City of Stockholm was very generous, I think, in their cooperation with all the other actors. They really raised up their hand and invited everyone to participate. And I think that's one of the main success factors for Stockholm." (Stockholm consultancy director, interview, Nov 9 2015)

The development sector was brought to the table as a collaborator to provide feedback on what kinds of targets are achievable and to jointly develop institutional processes. In this way, the development of the eco-district became not just a way to implement low carbon buildings and energy infrastructure, but also a targeted coalition building process with industry. Similarly in the UK, a non-profit organization called the Zero Carbon Hub was established as a place for industry to discuss and inform implementation related to the policy target for all new homes to be zero carbon by 2016. The Hub drew together a broad cross section of the development industry to define 'zero carbon' and sort out what implementation would look like. As one employee reflected:

> "I think what we successfully did is we created a safe area of debate for the industry. So we had an overall steering group that had representatives from deep green through to commercial house builders and technical planning product manufacturers, building control, everybody in the middle" (London environmental non-profit representative, interview, Oct 6 2015)

Through Hub workshops, a coalition of support was built for the zero carbon homes target. There was significant outcry when a new UK government withdrew from the zero carbon homes target in 2015, but the coalition was not strong enough to prevent the cancellation. Finally, coalition building with the private sector was also important in San Francisco. Key green building policy initiatives started with formal public-private committees: "The energy

performance ordinance came out of a Task Force that was formed of private sector and public stakeholders looking at how to improve energy efficiency in the commercial building stock. So a lot of these things are policies that grow out of partnerships with the private sector" (San Francisco local public utility representative, interview, Apr 13 2016). Industry leaders who had credibility in the sector were chosen to participate and the resulting green building ordinance had wide support. The political support developed through targeted coalition building with industry can entrench decarbonization into building development standards.

Coalition building made decarbonization initiatives particularly 'sticky' or difficult to withdraw from by offering returns to participants. Industry that joined the coalition shaping the standards for the Stockholm Royal Seaport, for example, gained access to the premium urban land for development. More broadly, an industry association representative in Stockholm explained that "It's good business for our member companies but to build new energy efficient buildings because…you get paid a bit more" (Stockholm development industry representative, interview, Nov 24 2015). Green building becomes a premium offering for developers and a resource for reputation building: "For our own reputation, we'd far sooner have an increased share of the green marketplace than the brown. The green being sustainable buildings and brown being just the average" (London development industry representative, interview, Oct 1 2015). When participation in the coalition brings returns, more actors seek to join the coalition and there is more support for entrenchment of decarbonization in development standards. However, concerns were also noted about building neighbourhoods from scratch:

> "…for example, the only people who can afford to live there is white, middle-class people who have a steady income. So, that's a problem because if you build a completely new district, and the average rent or condo prices are really high, how does it look in

five years?" (Stockholm development industry representative, interview, Nov 23 2015)

While the use of premium urban land may incentivize corporations to participate, it also increases the cost of decarbonized new buildings, which has equity implications.

Coalition building within local government and agencies also supported the entrenchment of decarbonization, but in different ways than coalition building in the private sector. Municipal governments are major players in urban development; The City of San Francisco, for example, is the biggest builder in the Bay Area. However, many municipal departments and agencies do not see environmental action as a key part of their mandate. To address this, some local government actors sought to entrench decarbonization priorities broadly across government operations using coalition building tactics. In San Francisco, the Environment Department used friendly competition between departments and recognition of progress in order to encourage departments to internalize GHG goals. They found that some departments started to take ownership of low carbon transformation by incorporating energy and GHG targets into internal reporting and job descriptions and by connecting climate and energy action to other priorities (City of San Francisco environment department representatives, interview, Apr 11 2016). As a specific example, the airport in San Francisco began going beyond the city's green building requirements after seeing the impact of the airport's first LEED Gold building and making the connection to opportunities for reputation enhancement (San Francisco development industry consultant, interview, Apr 19 2016). Relatedly, in Stockholm, municipal agencies report on decarbonization targets regularly as a part of regular operations linked to the budget cycle. This institutionalization of decarbonization makes it clearer which agencies were successfully meeting decarbonization targets - essentially identifying the frontrunners of urban decarbonization implementation within local government (City of Stockholm planning department representative, interview, Nov 5 2015). The tools one can use

to motivate support for decarbonization are clearly different across the public and private sector. Nonetheless, coalition building was a key dynamic allowing decarbonization to be entrenched broadly across local government, particularly using the tools of competition, recognition and institutionalization.

4.3 Capacity building

In the case studies, urban actors used learning spaces to build capacity in ways that facilitated the scaling up of low carbon initiatives. For example, the Royal Seaport in Stockholm was described expressly as learning space to develop the capacity to deliver the most efficient buildings commercially possible. One municipal employee explained the capacity building role the Royal Seaport plays locally and internationally:

> "Many international delegations come…from universities, from cities, from companies and so on, who want to come here and see how we do it in Royal Seaport. And so it's both a window and for us a little bit of an experiment. To see what is possible to do" (City of Stockholm environment department representative, interview, Nov 10 2015).

The experiences from the eco-district allowed industry to develop technical skills and low carbon supply chains and allowed the local governance to experiment with new governance practices. In this way, the learning process expanded the cutting edge of low carbon development. The quote also shows the way that the Royal Seaport has been a learning space for universities and other cities, which shows the ways that these experiences have been scaled up internationally. In London, new developments for the Olympics were required to meet a building standard called Code 4 in the Code for Sustainable Homes. As one representative of the development industry explained, "that was quite challenging for the industry to deliver, but now that it's delivered, it

becomes - well why wouldn't you do Code 4? Because you've got a supply chain with all of the skills and expertise to deliver that" (London development industry representative, interview, Oct 1 2015). Capacity building across the supply chain creates opportunities for development companies to deliver lower carbon homes more broadly as normal practice. Finally, the whole city can function as a learning space that feeds in to state or nation-wide building standards. As one city of Stockholm employee explained, "We think that it's important that the cities who really have a good market could be in the front improving [building [standards]" (City of Stockholm development office representative, interview, Nov 4 2015). It is now planned that the Swedish building code in 2021 will require the same energy efficiency standard that is already required for new buildings in Stockholm (London environmental non-profit representative, interview, Sept 21 2015). Similarly, a participant in the research noted that the higher standards adopted by cities like San Francisco helped to broadly shift the market for urban development, which facilitated the adoption of higher state-wide standards (San Francisco environmental non-profit representative, interview, Apr 20 2016). Whether capacity relates to low carbon technical skills, governance practices, or supply chains, urban learning spaces can build capacity that scales up the accomplishment of low carbon new development.

Green building certifications are also supporting capacity building in ways that enable the scaling up and entrenchment of low carbon practices. Green building certifications have created entry level space to facilitate the acceptance of green building practices for new development: "I think the green building certification thing that has been successful, whether you like BREEAM, LEED and whether it actually leads to a more sustainable building or not, it is something that people, developers and investors do understand." (London development industry representative, interview, Oct 1 2015) If they understand certification, some groups begin to demand it for new developments. In Stockholm, commercial buildings that are not built to a certification (e.g. BREEAM or LEED) "would not be possible to rent out" since "tenants are very

demanding" and development financiers such as pension funds often require certification (City of Stockholm planning department representative, interview, Nov 5 2015). Of course, in terms of decarbonization outcomes for buildings, green certification systems "are rather weak sometimes" (City of Stockholm planning department representative, interview, Nov 5 2015) and "can be treated as a tick box exercise, but at least it ticks the boxes in terms of improving the performance in the design and construction phase of buildings" (London development industry representative, interview, Oct 1 2015). Nonetheless, the adherence to green certification standards can change what is considered accepted practice in building design, procurement and construction. This can lead to scaling up so that green building practices are applied more broadly. In San Francisco, "LEED and energy star [are] being used really extremely widely…And the bulk of it remains voluntary use of those tools. So you have effective market transformation occurring out of those labels" (City of San Francisco environment department representative, interview, Apr 14 2016). Voluntary green certification fills a capacity building role for the private sector in ways that facilitate entrenchment: "BREEAM has helped the sector trial this new thing out in a safe space, and now they've moved on in terms of knowledge and supply chain is there, the product is there, materials etc. So now that could be a requirement and it wouldn't have undue burden on the sector to achieve it" (London environmental non-profit representative, interview, Sept 21 2015). Green certification can therefore support the development of green building capacity in the private sector, which makes it possible to increase related standards enforced through the building code. Nonetheless, this capacity may be limited in critical ways, since scholars have found that some applications of certification programs like LEED fail to reduce energy consumption and GHG emissions compared to non-LEED buildings (Scofield, 2013).

Most of this section has dealt with new development. Existing buildings are also targeted by decarbonization initiatives, but only a limited number of initiatives are successfully scaling up

and becoming entrenched. Capacity building is a particularly important dynamic that is facilitating the expansion of some low carbon practices for building retrofits. Many of these capacity building initiatives have focused on technical capacity. In San Francisco, a municipal department has “a full service energy efficiency program focusing on largely government buildings” (San Francisco local public utility representative, Apr 13 2016) that is able to custom tailor energy retrofit proposals to public agencies that lack the financial incentives experienced in the private sector. Through two programs run by the GLA called RE:FIT and RE:NEW, GLA employees act as very low cost consultants to public and private building owners respectively to facilitate building energy efficiency retrofits. The programs have tried different models for incentivizing retrofits, but have found the most success through acting as consultants to provide energy services expertise to customers (Greater London Authority efficiency program representatives, interview, Sept 25 2015; Oct 2 2015). In addition to offering this technical capacity directly, local government programs are collecting or requiring the collection of key information. San Francisco developed a map of solar resource availability to facilitate investment in solar photovoltaic panels, for example, and the GLA developed a map of renewable heat sources to facilitate the development of district energy. San Francisco also requires large commercial buildings to collect and publish information about their building’s energy use, as well as conduct energy audits highlighting opportunities to save costs through energy efficiency retrofits. This technical information is intended to be a resource that enables decarbonization action to scale up. In addition, demonstration projects were important vehicles for capacity building related to energy retrofits for existing buildings. Multifamily residential apartment buildings were retrofitted in a Stockholm suburb called Jarva, for example, to achieve a 50% energy use reduction (City of Stockholm, 2015). Demonstration projects build the technical retrofit skills in the industry and act as an educational tool to show others that energy efficiency retrofits for these buildings are possible. Nonetheless, retrofitting residential rental buildings can also be controversial, particularly when buildings in low-income areas are

upgraded and rents increase as a result: “sometimes there can be fights about raising the rents and people are not very happy about having to move out” (Stockholm politician, interview, Nov 27 2015). Overall, some scaling and entrenchment is taking place for technical capacity building. RE:FIT has scaled up from a pilot project for 14 municipal buildings and the model is now being expanded nationwide (Greater London Authority environment department representative, interview, Sept 8 2015). In addition, San Francisco “advanced the state in its thinking“ (San Francisco environmental non-profit representative, interview, Apr 19 2016) and building energy use benchmarking is now required for state buildings across California.

Financial capacity building often complements technical capacity building initiatives. Often, electricity and gas utilities are required to deliver a certain amount of energy efficiency and choose to do so partly by incentivizing residential energy efficiency retrofits (e.g. upgrading insulation). This is the case with energy companies in the UK. Although some wall and attic insulation has taken place in London due to special incentive programs, in general, energy companies have been disinclined to focus on residential buildings in London because so many of the homes have solid walls and insulation retrofits are cheaper for hollow walls. In California, a number of programs have sought to incentivize energy efficiency retrofits, which have often been administered through investor-owned utilities. Efficiency programs have targeted appliances, lighting, HVAC, industrial manufacturers and agriculture using tools like financial incentives, research and development, standards, and education and outreach (CPUC, 2016). Renewable energy generation, particularly solar photovoltaics, is also to be financially supported. For example, incentive programs from the City of San Francisco support solar PV installation. Up to 2013, $15.5 million USD had been provided to reduce the installation costs of PV systems for residents, businesses and community organizations, including additional incentives for identified ‘environmental justice’ neighbourhoods that have experience higher historical levels of pollution (San Francisco, 2013). Some financial capacity building takes the

form of loans. In San Francisco, PACE (Property Assessed Clean Energy) financing programs offers loans to homeowners to do energy efficiency retrofits and renewable energy installation. The idea behind the model was that “it made financing more accessible to a broader range of people and there were hopes that the PACE program would fill a very important gap of how are we going to pay for all of these upgrades” (City of San Francisco environment department representative, interview, Apr 12 2016). Though it originally faced challenges because key national mortgage lenders contested the way it operates, recently the program has started to expand. A similar UK loan program for home energy retrofits called the Green Deal had poor uptake due to design and implementation problems and was cancelled. The local governments in the case studies are also using various tools available to them to offer financial capacity. The City of Stockholm owns approximately 20% of residential buildings in the city through five public housing companies that rent apartments to a range of incomes. When the energy efficiency requirements housing companies had to meet were increased, they had access to large budgets for energy efficiency retrofits. After a few years when capacity had been built, efficiency upgrades were instead mainstreamed into budgeting (City of Stockholm environment department representative, interview, Nov 10 2015). In this way, energy efficiency retrofitting was entrenched into the operations of Stockholm’s housing companies. Financial capacity building helped local governments entrench and scale up decarbonization initiatives in other ways, including the use of local government buying power to spur innovation in low carbon buildings (“using [public spend] almost as trailblazers” [London environmental non-profit representative, interview, Oct 6 2015]) and the creation of market demand by mandating higher levels of energy and greenhouse gas performance for municipal buildings (London environmental non-profit representative, interview, Oct 6 2015). Technical and financial capacity building can scale up and entrench decarbonization initiatives, but experiences so far are fragmented and limited to only some sections of the existing built environment.

Table 4 Summary of evidence of political dynamics of decarbonization in Stockholm, London and San Francisco cases

Political mechanisms of systemic change	**Evidence from analysis of political dynamics supporting poltiical effectiveness in implementation**
Norm change	- Norms drawing on discourses about the inevitability of decarbonization were reinforced by planners and NGO representatives to garner buy-in from others (e.g. developers) to support the implementation of decarbonization initiatives, including requiring low carbon and energy efficiency performance above and beyond regulated requirements - Voluntary action allowed developers to get used to requirements for low carbon buildings, allowing local governments to subsequently incorporate them into mandatory requirements - Changing professional practices (e.g. from good development meets standards in Stockholm, to good development beats energy efficiency standards by 20%) contributed to the development of broader cultural norms supportive of decarbonization
Coalition building	- Political support for decarbonization standards for new buildings was developed through targeted coalition building among industry and between government and industry - Decarbonization initiatives were made difficult to withdraw from by offering returns to participants (e.g. industry that joined the coalition shaping the standards for the Stockholm Royal Seaport gained access to the premium urban land), although this often meant premium urban land was the focus for decarbonization - Local government environment department employees catalyzed the integration of decarbonization into the mandates of other government departments and agencies using competition, recognition, and institutionalization processes
Capacity building	- Dedicated learning spaces in cities with higher decarbonization targets developed capacity that enabled decarbonization implementation through both technical means (e.g. research and

	development on cutting edge energy efficiency) and institutional means (e.g. new governance practices allowing for monitoring of performance throughout development) - Green building certifications built technical capacity in the private sector, which made it possible for governments to feel confident that they could increase related standards enforced through the building code (although certification programs are notably limited) - Governments have offered various programs to build financial capacity and technical capacity for residential and public sector building retrofits, but they have been limited in scope

5. Discussion: Developing political momentum for urban decarbonization

Political momentum is under development related to new urban buildings. Norm change, new coalitions of support, and capacity building are all allowing decarbonization initiatives to scale up and become entrenched through implementation in ways that could catalyze systemic change. In particular, new norms about what constitutes 'good' urban development are under development providing some momentum. Furthermore, coalitions of support are being built that target powerful and influential players in urban development. Finally, capacity building is continuing to push forward the cutting edge for decarbonization in new developments. There are notable concerns as well, including coalitions structured to affirm inequitable outcomes through influential roles for corporate interests and the limited empowerment of citizen groups. This raises issues of unequal access to the decarbonized city, which was also a concern noted by some participants in the research. Who will be able to afford to live in low carbon developments if they are pursued as premium urban space? Who will be blamed for GHG emissions when the rich live in this premium space while the poor remain in inefficient housing? The findings show that political dynamics are creating momentum in the expansion and entrenchment of

decarbonization initiatives for new urban development, which suggests that systemic change may continue to build over time towards decarbonized new urban development, but these concerns call the equity outcomes of this particular decarbonization pathway into question.

The development of political momentum enabling the implementation of decarbonization is more limited in the existing building sector. There has been success when it comes to capacity building and some initiatives that have sought to build technical and financial capacity have scaled up (e.g. GLA's RE:FIT program replicated at the national scale) and become entrenched (e.g. requirements for municipally owned housing agencies to achieve energy efficiency targets in Stockholm). However, the scope of impact on the existing building sector has been limited, particularly if one considers the scope of the challenge. In order to achieve decarbonization by mid-century, existing buildings in developed countries would need to annually renovate a minimum of 2% to 3% of the total existing building to 50% lower energy use than the national average (Architecture 2030, 2014). While there has been success in retrofitting buildings under local government control, efforts to catalyze retrofits in the commercial or residential sector have encountered barriers. Even when residential energy efficiency programs have been broadly delivered by energy companies, the scope of retrofits has been limited since targets and incentives are incremental. This is not surprising since energy efficiency is narrowly conceptualized as a technological intervention abstracted from the social world and it is deployed in ways that actually reproduce resource intensive ways of life (Shove, 2017). As a result, the improvements tend to improve the efficiency of the system while failing to fundamentally overcome carbon lock-in. Capacity building is developing only limited pockets of political momentum for existing building decarbonization.

In light of this analysis, there are two key points that may support the development of political momentum to enable the implementation of decarbonization intiatives targeting existing

buildings in the future. Although norm change and coalition building were important for new buildings, there is limited evidence that these political dynamics are being harnessed when it comes to the existing built environment. Existing building decarbonization efforts may be more politically effective in implementation if proponents pay increased attention to changing norms and building political and economic support through coalitions. In addition, there is frequently a focus on the instrumental role for an initiative in terms of the solution if offers (i.e. providing information). Catalyzing building retrofit requires a broad ecosystem of policies and conditions (Jankel, 2015; The Carbon Trust, 2009). Barriers to implementing housing retrofit have been identified as "a lack of information on the true costs and benefits of retrofit, the perception among homeowners and their funders that the business case is weak, fragmented ownership structures, a lack of finance and access to capital, and a lack of a trained workforce" (Jankel, 2015). As a result, there is often a focus on assembling bespoke policies and programs that instrumentally address missing components of capacity. This paper shows that politically effective implementation of decarbonization initiatives for existing buildings filled instrumental needs in addition to facilitating broader political dynamics. Therefore, decarbonization is not just about making sure the tools are at hand (e.g. information about building energy use, loans for energy upgrades), but it is also a process of triggering political dynamics that build momentum through the process of implementation. Future urban carbon governance of existing buildings should consider the complementary roles of instrumental solutions and political dynamics to develop political momentum for decarbonization implementation.

6. Conclusion and Policy Implications

This paper expands the toolkit available to consider progress towards decarbonization. To complement dominant approaches focused on accounting for GHG emissions, this paper evaluated political effectiveness in the implementation of decarbonization targeting urban

buildings and evaluated the implications for the development of political momentum toward systemic change. The findings showed that new urban development is often low carbon and is building political momentum in implementation through norm change, new coalitions of support, and capacity building. However, urban actors' efforts to change the existing built environment have faced challenges and the development of political momentum within the existing buildings sector has been limited. Socially just decarbonization will depend on expanding successful implementation beyond new, elite urban developments. Overall, I have advanced two main arguments in this paper: 1) reframing the policy goal of urban climate mitigation to decarbonization productively refocuses attention on systemic change, and 2) effective urban carbon governance is not only about providing instrumental tools, but it also involves triggering political dynamics that build momentum.

This paper also offers insights into how other urban actors can catalyze low carbon transformations beyond the case study cities. In particular, the findings show how political levers can be pressed to make change. The development of new norms about the inevitability or desirability of low carbon buildings helped urban actors to entrench decarbonization into standards for new buildings. Shifting professional norms was particularly important to facilitate the implementation of decarbonization initiatives. The political lever of coalition building can also be influential; practitioners have used tools like competition and recognition to entrench decarbonization priorities into the activities of agencies that have no clear climate change mandate. Urban actors in the case studies also found that decarbonization could be entrenched into mandatory standards for new developments through coalition building with the private sector that offered opportunities for deliberative participation and increasing returns. Finally, special decarbonization zones in cities for capacity building can help decarbonization initiatives to scale up through the development of technology, governance, and skills for both new and existing buildings. Urban practitioners should also note the concerns and limitations arising from

carbon governance so far. In particular, decarbonization in practice needs to find ways to pursue equitable decarbonization of buildings. Since carbon governance is finding success in decarbonization for new buildings in premium urban areas, unequal access to the decarbonized city is developing.

It is important to consider the limited geographic scope of this analysis to wealthy cities in the Global North when considering the transferability of the findings. While these cases offer insight into early attempts to pursue decarbonization, there can be many paths to transformation. Care should be taken when applying these insights and future work can build theorization from different places. In particular, more work needs to done on urban climate and energy transformations from the perspective of urban areas in the Global South. Other potential avenues of inquiry include responding to the critical need to better understand how to catalyze systemic change in the existing built environment and more deeply explore the issues of unequal access to the decarbonized city.

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